

## INFLUENCE OF NICOTINE CONTENT IN THE NEUTRAL FRACTION OF

### CSC ON COMPLETENESS AND STRENGTH OF SMOKE TASTE

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#### SUMMARY

Organoleptic properties (primarily "completeness" and strength) of a large number of cigarettes of various smoke qualities have been examined. The nicotine content in the neutral fraction of cigarette smoke condensate (CSC) from these cigarettes was determined by GC. Separation of the neutral fraction was done under the approximate conditions that occur in the oral cavity (temperature, pH, presence of enzymes, ...). Investigation showed a high correlation between the nicotine content of the neutral fraction and smoke irritation and "completeness" and a medium correlation with smoke strength. The level of correlation differed amongst the different quality groups.

#### INTRODUCTION

Undoubtedly tobacco alkaloids are most often tested and investigated in tobacco and tobacco smoke (4, 5, 6, 8). These investigations encompassed organoleptic properties, too. However, the results are obscure, probably due to the complexity of the problem itself (difficulty in distinguishing alkaloid

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effect upon senses from effects of other numerous components), permanent changes of the conditions governing the formation of smoke and eventually individual interpretation by degustators. Most of the authors agree that the physiological strength of smoke depends directly upon the nicotine content in tobacco (consequently in smoke with known transfer conditions). The reports on nicotine's role in other sensory qualities vary. Some authors (7, 9, 10, 11) state that it has definite negative correlation with quality; others (1) indicate significant positive correlation (especially with taste strength) and some have not found a consistent relationship (2, 15, 16).

Considering water solubility of nicotine and the fact that primary sensory effects are formed in the oral cavity we have tried to find the role which nicotine dissolved in saliva can have in organoleptic properties. Keeping in mind pharmacology and the organoleptic characteristics of the pure substance we supposed that the primary effect would be demonstrated by strength and off-effects (irritation - biting in throat).

#### EXPERIMENTAL

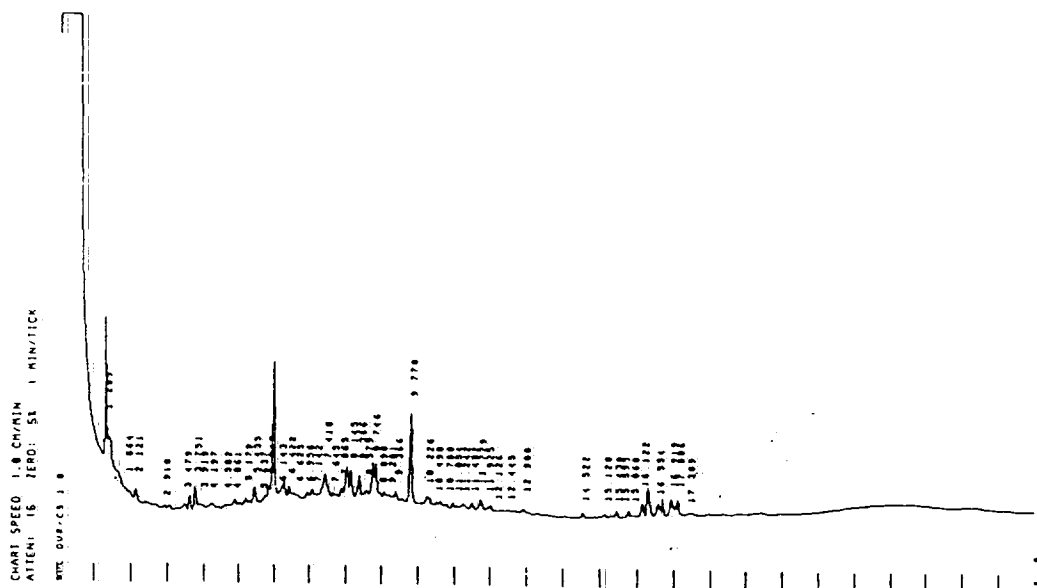
A one-year study with commercial cigarettes, taken by free choice, from all quality groups of Yugoslavian cigarettes was conducted. We have paid attention to examine all cigarette brands of our market. This made up a sample of 4320 cigarettes.

All tested cigarettes were conditioned for one week at 21°C and 60% relative humidity and selected on a weight and pressure drop basis. The cigarettes were smoked on the smoking machine RM-20 Heinr. Borgwaldt by the standard method of CORESTA.

Tubes with CSC were rinsed continuously with saliva imitation at 36°C with liquid flow rates according to the mean puff flow rate. Further fraction separation was done by the method of Snook (12).

The samples of the neutral fraction were analysed on Varian 3400 gas chromatograph equipped with capillary column DB-1. The

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RECALCULATE ON FILE: KAPIL214

CHANNEL: 10 - 1

TITLE:

12:32 14 APR 87

SAMPLE: 3 - N

METHOD: RF10

CALCULATION: AS - ANALYS

PEAK NO	PEAK NAME	RESULT AREA1	TIME (MIN)	TIME OFFSET	AREA COUNTS	SEP CODE	W1/2 (SEC)
1		7.2180	1.209		105072	BU	1.00
2		1.0249	1.375		15031	UV	1.50
3		1.7200	1.406		25230	UV	1.15
4		1.1264	1.441		16520	UV	1.13
5		0.9134	2.121		13302	BU	3.30
6		0.6035	3.479		10025	BU	4.94
7		1.1379	3.610		16609	UV	3.00
8		1.0397	3.751		25301	UV	3.13
9		1.2019	4.061		10000	UV	7.06
10		0.9009	5.179		14306	UV	6.31
11		2.2290	5.435		32704	UV	6.00
12		0.7772	5.700		11399	UV	4.31
13		2.0590	5.843		30210	UV	4.50
14		12.9372	5.950		190619	UV	3.06
15		1.4005	6.203		20540	UV	3.34
16		2.0577	6.277		30179	UV	8.00
17		1.4901	6.422		21971	UV	4.50
18		0.7010	6.956		10232	UV	4.44
19		0.0996	7.064		13194	UV	4.00
20		5.2304	7.410		76710	UV	7.30
21		0.7033	7.645		11576	UV	3.06
22		1.2154	7.065		17025	UV	4.25
23		5.0737	0.021		74412	UV	7.69
24		3.1206	0.145		45005	UV	3.69
25		2.9149	0.366		42751	UV	3.44
26		1.4032	0.579		21753	UV	4.30
27		4.0570	0.746		59513	UV	4.13
28		3.5503	0.026		52069	UV	3.75
29		0.9951	0.090		14595	UV	10.69
30		1.1329	0.050		16615	UV	3.94
31		0.6997	0.133		10262	UV	2.31
32		1.2052	0.366		10049	UV	3.31
33		7.7919	0.770		114277	UV	3.30
34		0.7005	10.226		11565	UV	4.00
35		1.3013	11.242		19005	UV	8.00
36		0.0670	11.402		12727	UV	4.30
37		1.7755	11.729		26040	UV	5.00
38		0.6921	15.742		10150	UV	4.15
39		1.5566	16.122		27029	UV	4.94
40		3.4694	16.206		50003	UV	4.63
41		1.6228	16.554		23001	UV	6.63
42		1.7790	16.690		26091	UV	4.50
43		2.1953	16.919		32196	UV	6.30
44		2.0542	17.006		30127	UV	6.06

TOTALS: 100.0000

1466610

DETECTED PKS: 96 REJECTED PKS: 52

MULTIPLIER: 1.00000

NOISE: 34.3 OFFSET: 133064

ERRORS:

AOC OVERANGE

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injection temperature was 250°C, the detector temperature was 300°C and the oven temperature was programmed from 50°C to 250°C at 15°C/min. The carrier gas, helium, was maintained with flow rate of 3 ml/min. Identification of the nicotine maximum was done on Finnigan MAT 8230 mass spectrograph under the same working conditions (Fig. 1 - the example of GC and MS identification).

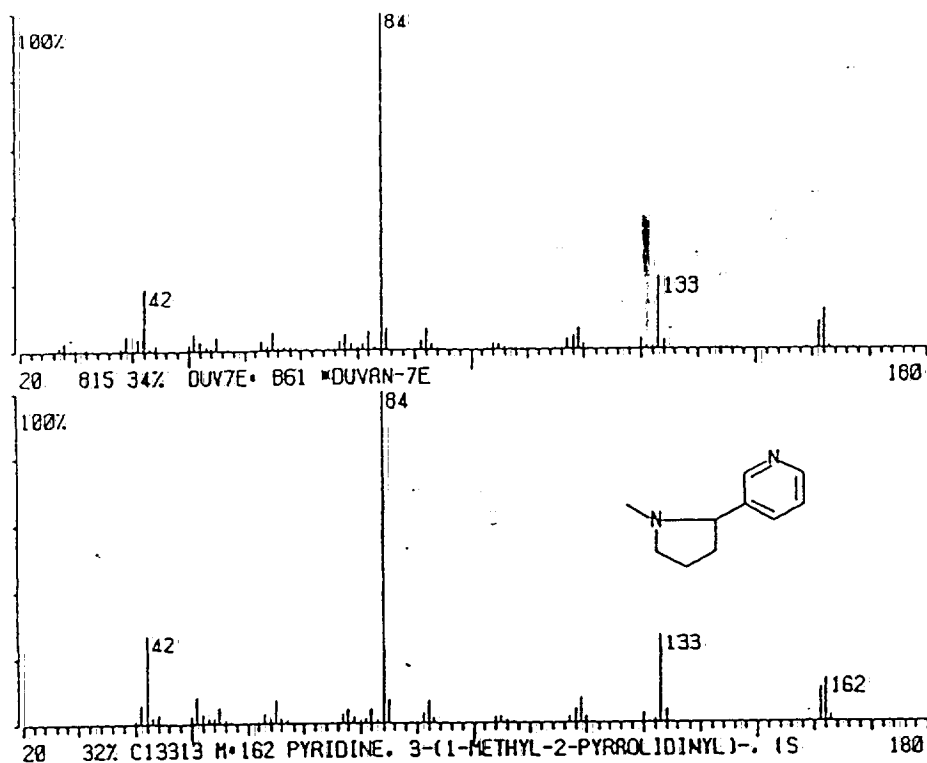


Fig. 1: The gas chromatogram obtained from neutral fraction of one cigarette of 3<sup>rd</sup> quality group

Degustation of cigarettes was carried out by an internal degustation system of the degustation board from the tobacco factory of NAIS. This system allots an equal number of points (1-10) for each sensory quality in three categories - very, medium and little. Descriptive estimation follows each number of given points.

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The statistical analyses were done with a programme for multiple correlation on a personal computer PC-12.

## RESULTS AND DISCUSSION

The results of CSC separation are summarized (average values) in Table 1.

Quality group	CSC mg/cig.	Nicotine in CSC	Neutral fraction (mg/cig.)	Neutral fraction (% in CSC)	Nicotine in NF (%)
License	19,36	1,34	6,17	31,85	1,03
Extra q.g.	20,22	1,41	6,90	34,12	1,42
1 <sup>st</sup> q.g.	21,40	1,02	9,03	42,17	1,89
2 <sup>nd</sup> q.g.	21,51	1,07	9,25	42,23	1,73
3 <sup>rd</sup> q.g.	23,51	1,49	12,19	51,85	1,91
4 <sup>th</sup> q.g.	24,17	1,51	13,59	56,24	2,17

Table 1: Parameters of CSC  
- middle values for 360 cigarettes  
in each quality group

The results indicate that with decreasing quality the content of CSC increases, which was expected. The share of the neutral fraction and nicotine in it increases with decrease in the cigarettes quality too. These differences are particularly important for the percentual share of the neutral fraction for the best and the worst quality - up to 24, 36%. Connecting these findings with the noticed organoleptic properties (Tab. 2), we have found out that if the portion of the neutral fraction exceeds 50% of CSC, the smoke coated tongue gave the impression of "greasiness". The sensations of biting and burning are insignificant for the 2nd quality group; middle for 1st and 3rd quality group and are accentuated for the cigarettes of 4th quality group. By the same order the nicotine content in the neutral fraction increases (Tab. 2).

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Quality group	Completeness (points)	Correlation coef. $r_1$	Strength (points)	Correlation coef. $r_2$
License	7,839	0,78	3,052	0,69
Extra q.g.	7,631	0,82	6,795	0,71
1 <sup>st</sup> q.g.	7,108	0,82	6,704	0,68
2 <sup>nd</sup> q.g.	0,891	0,86	6,635	0,66
3 <sup>rd</sup> q.g.	6.542	0,87	6,333	0,61
4 <sup>th</sup> q.g.	6,353	0,89	6,238	0,63

Table 2: Relations between nicotine content in neutral fraction of CSC and some organoleptic properties (average values)

The intensity of these irritating effects violates the fullness of "completeness". The middle values cannot show the real differences. According to them, except license cigarettes, which have full "completeness", all the others can be judged as cigarettes with middle "completeness". However, the statistical analyses of multiple variations give correlation coefficients which explain the nature of relationship (Tab. 2). So we see that dependence of "completeness" on the nicotine content in neutral fraction is high. The degree of dependence is higher for the lower quality groups. This can be explained by the lesser effect and smaller number of other components in the fraction which can have a camouflage effect.

The influence of nicotine in the neutral fraction on strength is of middle range and almost the same within all quality groups. This indicates that, for strength, the nicotine content in the basic fraction is probably more important.

Forming the multiple regression equation for "completeness" (X),

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the portion of the neutral fraction ( $X_1$  mg/cig) and the nicotine content in the neutral fraction ( $X_2$  mg/cig) we arrive at the following equation :

Equ. 1 :

$$X = 11,6477 - 0,0758 X_1 + 0,6444 X_2$$

$$R_{1,2,3} = 0,9946$$

$$r_{1,2} = -0,9843$$

$$r_{1,3} = 0,7979$$

$$r_{2,3} = 0,6991$$

The conclusion is that the dependence of "completeness" on both factors is well defined with a very marked negative correlation with the portion of the neutral fraction in CSC and pronounced influence of nicotine in it. The dependence among the two factors themselves is medium ( $R_{2,3} = 0,6991$ ).

For strength (y) the equation is :

Equ. 2 :

$$Y = -1,8115 + 0,0647 X_1 + 0,0166 X_2$$

$$R_{1,2,3} = 0,8546 \quad r_{1,3} = 0,7079$$

$$r_{1,2} = 0,8365 \quad r_{2,3} = 0,8679$$

The dependence between the portion of neutral fraction and nicotine content in it is, in this case, more important ( $r_{2,3} = 0,8679$ ), which can, again, be explained by the camouflage effects of the other components found in the neutral fraction.

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